Winery lees: Minimising volumes and recovering better quality juice and wine

The AWRI is convening a workshop on winery lees at the 16th Australian Wine Industry Technical Conference in Adelaide in July. This workshop will consider sources of winery lees, methods of lees minimisation and techniques for juice and wine recovery. In this article, AWRI engineers **Simon Nordestgaard** and **Tadro Abbott** provide some preliminary data from recent AWRI research on winery lees. More details will be included in the July workshop.

IN WINEMAKING, lees are solids-containing mixtures that have been separated from juice or wine by gravity settling, centrifugation, flotation or other techniques. The solids can include grape material, tartrate precipitates, yeast cells, fining agents and oak chips. Since 2013, the AWRI has been working on a research project that aims to better understand the physical characteristics of different types of lees and investigate alternatives to traditional racking processes.

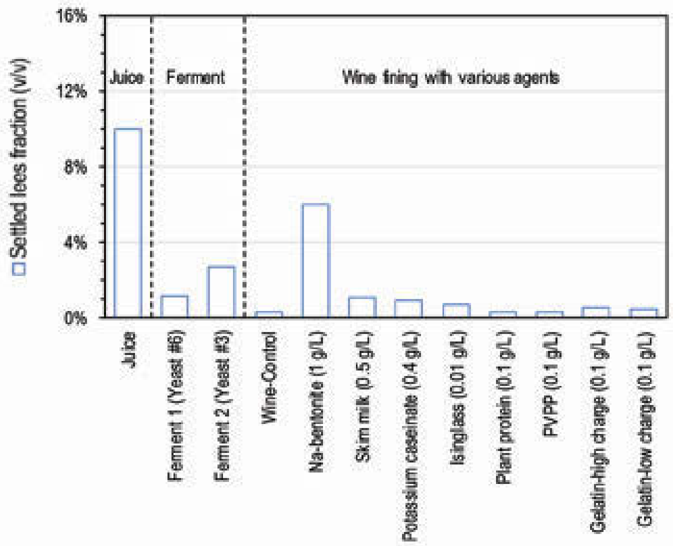

Figure 1. Lees volumes at different stages of white wine production from laboratory settling experiments

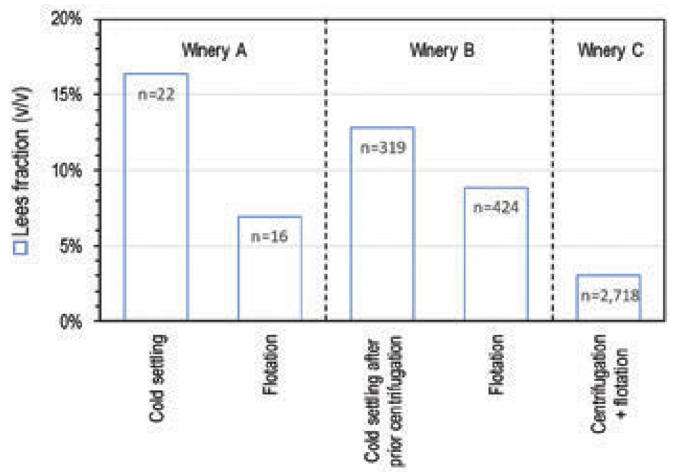

Figure 2. Median lees volume fractions resulting from different white juice clarification methods at three wineries (n=number of batches)

SOURCES AND VOLUMES OF LEES

Typically, the largest volumes of lees come from the grape. In white winemaking grape-derived solids are mainly removed prior to fermentation, whereas in red winemaking they are usually removed after fermentation when they are combined with yeast.

As an illustration of the relative lees volumes generated at different stages of wine production, data from some simple laboratory white juice/wine settling experiments performed in 2L cylinders are presented in Figure 1.

Cold settling gave 10% juice lees. In contrast, fermentation gave lees volumes between 1% and 3% (eight yeast types trialled - highest and lowest results shown).

Fining agents at typical doses also produced relatively small quantities of lees, with the exception of sodium bentonite, which is widely known for producing large volumes of lees (in this experiment 6% of the wine volume).

The solids content of the different lees varied – fermentation lees had four to five times the dry solids content of juice or bentonite lees.

WINERY DATA

To better understand lees volumes at a production scale, data from four large wineries were analysed. Figure 2 shows the lees volumes resulting from different methods of white juice clarification at three of the wineries (A,B and C).

Juice lees volume fractions were calculated using the formula (Volume of juice in – Volume of clear juice out)/Volume of juice in. At Winery A, with cold settling 16% of the initial juice volume was separated as lees while with flotation only 7% was separated as lees.

With flotation, the solids are lifted with gas bubbles and therefore there was less juice tied up with the solids than occurs with settling. Winery B used flotation alone or centrifugation followed by cold settling to achieve clarification.

Even after many of the larger solids had first been removed by centrifugation, the volume of lees obtained through cold settling was still higher than using flotation alone (13% compared with 9%). Winery C used centrifugation with flotation on the outlet of the centrifuge and this process produced a lees volume of 3%.

This lower lees fraction than at Wineries A and B is likely partly a consequence of the use of centrifugation to remove the larger denser solids and subsequent use of flotation to remove the lighter solids (both technologies which produce lees with low juice content).

It is also likely partly a consequence of Winery C's use of membrane presses for draining and pressing, which may have resulted in lower initial juice solids levels than occurred at Wineries A and B where inclined or static drainers and screw

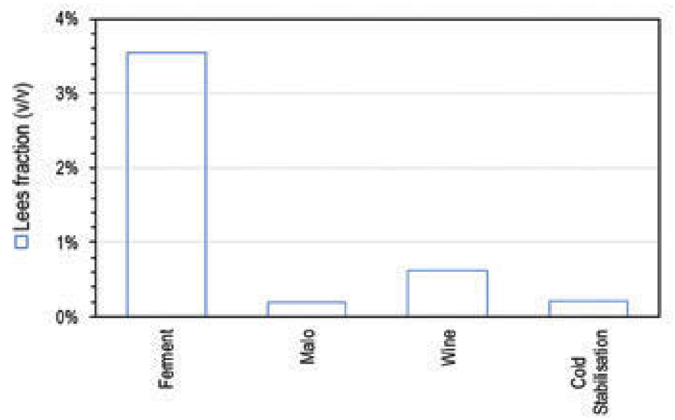

Figure 3. Aggregated lees fractions at different stages of red wine production at Winery D

presses were used for some operations. Types and modes of operation of crushing, draining and pressing equipment are important in limiting lees volumes in the winemaking process.

Bentonite lees volumes from one winery were also examined. Where sodium bentonite was used for heat stabilisation and this operation was coupled with cold stabilisation, the median settled lees volume fraction was 5.1% across 624 batches (data not shown).

The project also assessed lees volumes generated during red wine production. One winery, which removed gross red lees by settling, had a median settled volume of gross red lees of 9.6% across 518 batches.

At another winery, red wine lees volumes were assessed at different stages of production (Figure 3).

This analysis showed that gross red lees after fermentation contributed the highest percentage of lees compared to other stages of red wine production.

RECOVERY OF JUICE/WINE FROM LEES

The importance of lees volumes depends on how much product is tied up in the lees, how much product can be recovered, whether the recovered product is downgraded (either from being bound up in the lees or by the recovery process) and the cost and effort required for the recovery.

Rotary drum vacuum filtration (RDVF) is widely used for juice and wine recovery from lees. This technology is well suited to processing high solids feedstocks with very high recovery rates, but can degrade juice or wine quality through oxidation. It also employs perlite filter aid that requires disposal.

In recent years, equipment suppliers have introduced cross-flow filtration systems for processing lees, claiming that they are more automated and can recover higher quality juice and wine with lower turbidity.

Some of the new systems are only suitable for light juice lees, while others are also designed to handle thicker fermentation lees and abrasive fining lees.

Many of the new lees filters are similar to the suppliers' existing wine cross-flow filters but with some important adaptations – e.g. wider bore capillaries, brushing/sweeping systems at capillary inlets and rotary pre-screens to remove coarse contaminants like seeds.

Another common configuration of lees filters has the filter surface on discs instead of on the inside of the capillaries and achieves the cross-flow filter surface cleaning action by rotating the discs in the lees instead of pumping the lees through the capillaries.

Decanter centrifuges are also being used to process lees prior to further filtration. In another interesting development, an Australian manufacturer is offering a variation on the RDVF. ▸

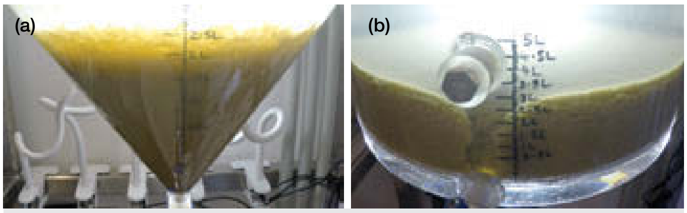

Figure 4. Pumping juice lees from underneath water in (a) a brewery-style tank with a 55° sloped conical bottom, and in (b) a winery-style tank with a 5° back-to-front sloped base. Lees channelling can be seen in the winery-style tank.

This new device employs a permanent titanium membrane that does not require perlite and can be operated in an enclosed oxygen-free environment.

THE SEPARATION OF LEES FROM UNDERNEATH CLEAR JUICE OR WINE

Clarification is a major reason for moving juice and wine between tanks at wineries. After clarifying a product by settling, the clear liquid is racked to a clean tank and the lees are then typically pumped to another tank (often a mixed lees tank) for later reprocessing.

The original tank then has to be cleaned.

AWRI researchers have been studying the possibility of removing the lees directly out from underneath the clear liquid, so that the liquid can remain in the same tank, reducing both transfer steps and tank cleaning.

The practical challenges with this concept are in avoiding channelling of the clear liquid through the lees and in directing as much lees as possible towards the removal point without disturbing the lees-liquid interface.

To facilitate this research, a laboratory apparatus with transparent tanks was constructed to be able to see how different tank designs and modifications might influence lees removal. The apparatus includes scale-model cylindroconical brewery-style tanks (55° sloped bottom cone, Figure 4a) and winery-style tanks (5° bottom slope from back to the front of the tank) as is (Figure 4b) or retrofitted with baffles, suction feet, acoustic and other vibration equipment or sweeping arms.

To date the only techniques that have been reasonably successful in removing lees from below juice or wine are cylindroconical tanks and to a lesser extent sweeping arms.

Neither of these is really a desirable solution because they would both require significant investment to implement - either purchase of a new tank (a cylindroconical tank) or a major retrofit to an existing tank.

At the time of writing, work is being performed to investigate if there are other ways to achieve the sweeping arm effect with a non-permanent (and therefore less expensive) fixture.

CONCLUSION

The lees workshop at the Australian Wine Industry Technical Conference will expand upon the topics discussed in this article. There will be presentations from AWRI researchers on local and international research, and from industry speakers on their experience with different styles of equipment for juice/wine recovery from lees.

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Conference registrations are now open at:
www.awitc.com.au/registration.

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